Patient positioning (mobilisation) and bracing for pain relief and spinal stability in metastatic spinal cord compression in adults

Lee, Siew Hwa; Cox, Katherine M.; Grant, Robin; Kennedy, Catriona M.; Kilbride, Lynn

Published in:
Cochrane Database of Systematic Reviews

Publication date:
2012

Document Version
Publisher's PDF, also known as Version of record

Patient positioning (mobilisation) and bracing for pain relief and spinal stability in metastatic spinal cord compression in adults (Review)

Lee SH, Cox KM, Grant R, Kennedy C, Kilbride L

THE COCHRANE COLLABORATION®

This is a reprint of a Cochrane review, prepared and maintained by The Cochrane Collaboration and published in *The Cochrane Library* 2012, Issue 3

http://www.thecochranelibrary.com

WILEY

TABLE OF CONTENTS

[Intervention Review]

Patient positioning (mobilisation) and bracing for pain relief and spinal stability in metastatic spinal cord compression in adults

Siew Hwa Lee[1], Katherine M Cox[2], Robin Grant[3], Catriona Kennedy[1], Lynn Kilbride[1]

[1]School of Nursing, Midwifery and Social Care, Faculty of Health, Life & Social Sciences, Edinburgh Napier University, Edinburgh, UK. [2]College of Medicine, University of Edinburgh, Edinburgh, UK. [3]Edinburgh Centre for Neuro-Oncology (ECNO), Western General Hospital, Edinburgh, UK

Contact address: Lynn Kilbride, School of Nursing, Midwifery and Social Care, Faculty of Health, Life & Social Sciences, Edinburgh Napier University, Edinburgh, UK. L.kilbride@napier.ac.uk.

Editorial group: Cochrane Pain, Palliative and Supportive Care Group.
Publication status and date: New, published in Issue 3, 2012.
Review content assessed as up-to-date: 13 February 2012.

Citation: Lee SH, Cox KM, Grant R, Kennedy C, Kilbride L. Patient positioning (mobilisation) and bracing for pain relief and spinal stability in metastatic spinal cord compression in adults. *Cochrane Database of Systematic Reviews* 2012, Issue 3. Art. No.: CD007609. DOI: 10.1002/14651858.CD007609.pub2.

ABSTRACT

Background

Many patients with metastatic spinal cord compression (MSCC) have spinal instability but are determined, by their clinician, to be unsuitable for surgical internal fixation due to their advanced disease. Mobilisation may be hazardous in the presence of spinal instability as further vertebral collapse can occur. Current guidance on positioning (or mobilisation) and spinal bracing is contradictory.

Objectives

To investigate the correct positioning (or mobilisation) and examine the effects of spinal bracing to relieve pain or to prevent further vertebral collapse in patients with MSCC.

Search methods

The Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE, EMBASE, CINAHL, CANCERLIT, NICE, SIGN, AMED, TRIP, National Guideline Clearinghouse and PEDro database were searched; the last search was run in February 2012.

Selection criteria

We selected randomised controlled trials (RCTs) of adults with MSCC of interventions on positioning or mobilisation and bracing.

Data collection and analysis

Two review authors independently assessed each possible study for inclusion and quality.

Main results

One thousand, six hundred and eleven potentially relevant studies were screened. No studies met the inclusion criteria. Many papers identified the importance of mobilisation but no RCTs have been undertaken. No RCTs of bracing in MSCC were identified.

Authors' conclusions

There is lack of evidence based guidance around how to correctly position and when to mobilise patients with MSCC or if spinal bracing is an effective technique for reducing pain or improving quality of life. RCTs are required in this important area.

PLAIN LANGUAGE SUMMARY

Patient positioning or mobilisation and bracing for pain relief and spinal stability in adults with metastatic spinal cord compression

People with advanced cancer may develop metastatic spinal cord compression (MSCC), a serious complication which can cause pain and mobility problems and possibly paralysis. MSCC is the spread of the cancer to the spinal column. A diagnosis of MSCC normally indicates advanced disease and for many patients the final stages of their illness. Knowing how to manage this condition is challenging for healthcare professionals who may need to decide what interventions are appropriate. Some existing guidelines suggest strategies such as bed rest, avoiding mobility and the use of braces as ways of managing this condition. However, this needs to be balanced against the wishes of the patient, ensuring their comfort and individual preferences. If life expectancy is short then a palliative care approach, which focuses on patient preferences and priorities, is appropriate. This review tried to establish what evidence exists to help healthcare professionals and patients decide what treatment (positioning or mobilisation, bracing) is best for them. Unfortunately little research exists which can tell us the best way to manage this condition. Therefore our suggestions are twofold. Firstly there needs to be more research undertaken to find out what treatment approaches can help. Secondly, in the absence of clear evidence, healthcare professionals and patients need to discuss the options and precedence be given to the expressed wishes of patients.

BACKGROUND

Description of the condition

Metastatic Spinal Cord Compression (MSCC) is a serious complication of cancer disease. The symptoms of MSCC range from minor sensory disturbance and autonomic changes to severe pain and irreversible paralysis. MSCC is defined as "compression of the dural sac and its contents (spinal cord and/or cauda equine) by an extradural tumour mass. Clinical features include any or all of the following; pain (local or radicular), weakness, sensory disturbance and/or evidence of sphincter dysfunction" Loblow 1998. The onset of MSCC is a medical emergency and warrants immediate intervention to minimise damage to the spinal cord and preserve neurological function. Prognosis and the quality of life are related to the patient's pre-treatment ambulatory status and rapid diagnosis and treatment is required (Levack 2002).

Controversy surrounds the care of patients with MSCC. Approximately 10 people per 100,000 a year suffer from this condition and their prognosis is known to be very poor (Levack 2002; Posner 1995). Current acceptable treatment approaches for MSCC include corticosteroids, radiotherapy and surgery (Loblow 1998). A course of the corticosteroid dexamethasone is prescribed to reduce the oedema and cord compression and thereby relieve pain. There is some controversy regarding the optimal dose of dexamethasone. The standard dose administered is 16 mg/d, in divided doses, over several days. Radiotherapy alone is the most common treatment for MSCC. Radiation therapy reduces the tumour mass thereby alleviating pain and relieving the spinal cord compression. There are different regimes of radiation therapy for spinal cord compression and the commonly prescribed regime is 3 Gy per fraction (Kwok 2005).

Surgery may be indicated, particularly for those with spinal instability or rapidly progressing loss of neurologic functions, but the number of these patients is small. Surgery is usually limited to patients with involvement of one or two vertebrae and those who have good performance status and an expected survival of more than three months (Rades 2006). The desirability of surgery plus radiotherapy as opposed to radiotherapy alone has been debated and two studies claim that where the overall condition of the patient merits intervention, a combination of surgery plus radiotherapy may provide the best outcomes (Patchell 2005; Thomas 2006). Tokuhashi 2005 developed a prognostic indicator as part of the assessment for surgery. This tool uses six parameters (performance status, extraspinal bone metastases, quantity of metastases in the vertebral body, metastases to internal organs, primary site, and the severity of neurological damage). Other tools to identify a patient's suitability for surgery have been developed by Bilsky 2007

and Gasbarrini 2010. The NOMS (Neurological assessment, Oncologic assessment, Mechanical instability and Systemic disease) framework developed by Bilsky 2007 and the algorithm for surgical treatment by Gasbarrini 2010 both require further evaluation. A study analysing cost-effectiveness found that surgery together with radiotherapy was likely to be cost-effective, in comparison with radiotherapy alone, in the Canadian context (Thomas 2006). Due to lack of evidence and data from prospective randomised controlled trials (RCTs), the treatment of MSCC remains controversial (Loblow 1998; Makris 1995; Prasad 2005). Presently, care of MSCC patients is based on individual clinician preference rather than evidence based guidelines. The lack of such guidelines has been shown to cause delays and discrepancies in patient treatment (Levack 2002; McClinton 2006).

Bracing and positioning or mobilisation are two non-invasive treatment options that clinicians sometimes prescribe for people with MSCC. The role of bracing as a treatment for MSCC is not well defined (Lewandrowski 2006). Braces can be used post-operatively to maintain the integrity of the spine, although anecdotally this treatment is criticised as being pointless as this is the purpose of the surgery. Braces can also be used long term to treat spinal instability, however, as the life span of a patient with MSCC may be short their use in this context is limited (Lewandrowski 2006). Both the cervical and thoracic spine can be braced, however, cervical bracing is the most commonly used in MSCC (Lewandrowski 2006). Positioning (or mobilisation) is a treatment that is prescribed pre-operatively, post-operatively and long term for people with MSCC. The prescription is usually bed rest or to mobilise. Bed rest usually refers to the patient being nursed supine and to mobilise refers to allowing the patient to get out of bed and walk. Clinically the rationale for bed rest is usually related to the spinal stability status (NICE 2008). An audit conducted by McClinton and Hutchison highlighted a lack of guidance on how to correctly position patients or whether or not to use braces (McClinton 2006). More recently, the National Institute for Health and Clinical Excellence (NICE) developed recommendations for the diagnosis and management of adults with MSCC (NICE 2008) in response to a recommendation from the Department of Health. These represent the best available good practice guidelines for managing patients with MSCC and allude to the use of bracing and positioning. However, the evidence that supports these recommendations is not conclusive.

Description of the intervention

Positioning (or mobilisation) for the purposes of this review refers to the instructions that patients receive about how to correctly position themselves and whether they can mobilise with MSCC. Patients with an unstable spine or with unknown stability status are usually nursed in a supine position and bed rest is recommended to prevent further vertebral collapse (NICE 2008; Pease 2004). There are conflicting opinions about these interventions, with some patients encouraged to mobilise (Walji 2008).

The supine position can increase pressure and pain for MSCC patients and there are several anecdotes of patients sleeping in an upright position to relieve the pain caused by lying supine (Bilsky 1999; Bilsky 2006; Gilbert 1978; Obbens 1987). Additionally, some patients experience a depressed mood when laying supine for extended periods of time (Pease 2004). Deep vein thrombosis (DVT), chest infection, pressure sores and urinary tract infections can pose additional complications for patients who are lying supine (Pease 2004) and, as a result, one guideline suggests that patients with a short life expectancy should be in a sitting-up position to avoid the aforementioned complications related to bed rest (Jacobs 1999). A primary goal of healthcare professionals is to rehabilitate patients. However, concerns about causing pathological fractures may mean mobilisation is discouraged amongst patients with MSCC for fear of paralysis (Bunting 2001). Additionally, it has been reported by patients with spinal instability that they suffer increased pain whilst sitting or standing due to an increased axial load on the spine (Bilsky 1999).

Bracing is an intervention that can be used to stabilise the spine through prevention or delay of further vertebral collapse and may reduce pain. Braces provide an additional form of external support to the affected area of the spine (Lewandrowski 2006). The goals of spinal bracing are restriction of motion, realignment and support (Benzel 2001). Both nursing and surgical guidelines recommend bracing for patients with cervical lesions (Mercadante 1997; NICE 2008; Schiff 2003; Yarbro 2005). Despite these recommendations the use of bracing for patients with MSCC is controversial as there is currently no evidence base for the use or functionality of bracing in this group of patients.

Why it is important to do this review

It was important that this review of positioning (or mobilisation) and bracing was undertaken to ensure patients are cared for effectively. It was also important to ensure that healthcare professionals could draw on evidence to inform the care and management of patients with MSCC in terms of pain and spinal stability through prevention of further vertebral collapse.

OBJECTIVES

To investigate the correct positioning (or mobilisation) and examine the effects of spinal bracing to relieve pain or to prevent further vertebral collapse in patients with MSCC.

METHODS

Criteria for considering studies for this review

Types of studies

Randomised Controlled Trials (RCTs).

Types of participants

Participants of either gender with a confirmed diagnosis of MSCC.

Types of interventions

Interventions including spinal bracing and guidance for patients on positioning (or mobilisation), for example lying flat, sitting up, standing or mobilised, or both, versus patients who receive no therapy or no positioning guidance, or neither.

Types of outcome measures

Primary outcomes

- Radiologically confirmed effects of bracing on vertebral collapse under physiological load measured by vertebral column collapse rate, number of vertebrae involved in the problem area and bony impingement.
- Patient reported measures of pain relief, quality of life and satisfaction. Vertebral collapse will be measured by vertebral column collapse rate, number of vertebrae involved in the problem area and bony impingement.
- Reported adverse events.
- Primary outcome measures should be measured using valid and reliable assessment tools (visual analogue scores (VAS) and quality of life (QoL) scales e.g. European Organisation for Research and Treatment of Cancer (EORTC)).

Search methods for identification of studies

Electronic searches

The search strategy detailed in Appendix 1 was applied to the following databases (27th January 2012 and 13th February 2012). Individual search strategies for the Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE, EMBASE and CINAHL are replicated and also detailed in Appendix 1.

- MEDLINE (Ovid) (1950 to week 4, January 2012).
- EBM Reviews - Cochrane Central Register of Controlled Trials (Ovid) (13th February 2012).
- *The Cochrane Library* (to Issue 1, January 2012).
- EMBASE (Ovid) (1980 to Week 4, January 2012).
- CINAHL (EBSCO) (1982 to January 2012).
- Cancerlit PDQ (Physician Data Query) 10th February 2012.

Searches of the following websites were also undertaken.

- SIGN (www.sign.ac.uk): no results, 10th February 2012.
- NICE (www.nice.org.uk) guidance (http://www.nice.org.uk/Guidance/CG75), date issued November 2008.
- UK Clinical Research Network (www.ukcrn.org.uk) Portfolio Database: no results, 10th February 2012.
- TRIP (www.tripdatabase.com): no results, 10th February 2012.
- NHS Clinical Knowledge Summaries (http://cks.library.nhs.uk) - information based on NICE 2008.
- National Guideline Clearinghouse (www.guideline.gov), 10th February 2012
- PEDro - Physiotherapy Evidence Database (www.pedro.org.au): no results, 10th February 2012.

Searching other resources

The references of all studies identified as part of this review were examined to determine if further studies could be identified for inclusion within the review. This search identified no further studies for inclusion.

Data collection and analysis

Selection of studies

Two review authors independently assessed each potentially eligible study by reviewing the titles or abstracts for inclusion in the review and for its quality. Disagreements over inclusion were resolved by discussion or with a third review author, or both.

Data extraction and management

We developed a data extraction form based on the Cochrane Pain, Palliative and Supportive Care Group template. We planned to extract the following main sets of data from each included study:

- lead author,
- date,
- study participant inclusion criteria,
- participants (diagnoses, demographics, primary cancer site, gender, age),
- interventions (spinal bracing, positioning, pain relief),
- intervention setting (hospital, hospice, home),
- outcome measures (quality of life, pain scores),
- timing of outcome measures (upon diagnosis, post surgery, post radiotherapy).

At least two review authors were identified to independently extract data into the data extraction form. One review author was to enter data into RevMan with the other checking the accuracy of this data input.
Any discrepancies were to be referred to a third review author and any errors or inconsistencies resolved.
We entered any details regarding the studies we excluded in to the 'Characteristics of excluded studies' table; if any studies had been included they would have been entered in the 'Characteristics of included studies' table. If necessary, additional information would have been sought from the principal investigator of a study for clarification of published data or missing data.

Assessment of risk of bias in included studies

We intended to assess any bias of included studies in accordance with guidelines in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011). Two review authors were to independently assess the risk of bias in included studies, with any disagreements to be resolved through discussion with a third review author as arbitrator if required. We were to contact study authors for additional information if required. We were to provide a written commentary of risk of bias within the review text. Assessment of methodological quality would have been assessed and graded using the 'Risk of bias' table available within RevMan 5.

Measures of treatment effect

Data would have been analysed using the Cochrane Collaboration's Review Manager 5 software. As no studies met our inclusion criteria it was not possible to measure the effects of intervention.

RESULTS

Description of studies

See: Characteristics of excluded studies.

Included studies

The search strategy identified 1652 citations overall. We identified 41 duplicates. A total of 1611 potentially relevant studies were identified and screened for retrieval. We excluded abstracts which were not relevant to the review. For example, there were a large number relating to the range of therapies offered to people with MSCC for example surgery and radiotherapy. We obtained full text articles for 19 abstracts. Four of these articles were retrieved as there was no abstract available. These were then excluded as they were not reporting an RCT. We therefore found no studies meeting the inclusion criteria detailed above.

Excluded studies

The other eight articles were retrieved as they reported positioning and bracing recommendations and the methods used were not clear from the abstract. Seven of these eight articles were also excluded as they were not RCTs (Freundt 2010; Furstenberg 2009; Galasko 1991; Ippolito 1998; Rades 2010; Sciubba 2010; Spinazze 2005). One further study was found to be an RCT but did not report in their findings the impact of the intervention measures (positioning and bracing) in terms of the outcomes detailed for this review (Chi 2009). Reasons for exclusion are detailed in the 'Characteristics of excluded studies' table.

Risk of bias in included studies

As no studies met our inclusion criteria it was not possible to analyse the risk of bias.

Effects of interventions

Data would have been analysed using the Cochrane Collaboration's Review Manager 5 software. As no studies met our inclusion criteria it was not possible to measure the effects of intervention.

DISCUSSION

Positioning (or mobilisation) and bracing are interventions that are discussed and recommended within the literature to improve pain management and prevent further vertebral collapse amongst patients with MSCC (McClinton 2006; Mercadante 1997; NICE 2008; Pease 2004). However, as the evidence to support these recommendations is controversial this review aimed to investigate the correct positioning (or mobilisation) and examine the effects of spinal bracing to relieve pain or to prevent further vertebral collapse in patients with MSCC in order to assist healthcare professionals in their decision making.

There were no studies identified within this review that provided evidence to support the positioning (or mobilisation) or bracing techniques that should be used to manage pain or prevent further vertebral collapse, or both, amongst patients with MSCC. However, there were some studies identified that discussed these interventions and that may inform further studies or discussions. From the review of the literature, four studies (Bilsky 1999; Bilsky 2006; Bilsky 2007; Borm 2004) discussed the effect of positioning (mobilisation) on pain. Bilsky 1999; Bilsky 2006; and Bilsky 2007 suggest that when nursed in a supine position patients suffer an increased pressure or pain due to increased axial load on the spine and provide anecdotal evidence that patients request to sleep in an upright position to relieve pain. Borm 2004 found that diagnosis of spinal tumours can be difficult if there are concurrent signs of

degenerative changes in the spine. Their study found no significant difference in the frequency of back pain either at rest or under loading for both spinal tumours and degenerative disease of the spine. It was observed that a combination of back pain at rest and without back pain under loading only occurred in patients with spinal tumours, but these results were not statistically significant.

Some studies suggested that other factors than pain should be considered in positioning (or mobilisation) (Bilsky 1999; Bilsky 2007; Pease 2004). Some patients have experienced a depressed mood when laying supine for extended periods of time (Pease 2004) and other complications such as DVT, chest infection, pressure sores and urinary tract infections can pose difficulties (Pease 2004). Jacobs 1999 suggest that in light of some of these findings patients with short life expectancy should be encouraged to sit upright or to mobilise themselves.

From this systematic review, the review authors conclude that clear guidelines are needed to inform how to correctly position patients in order to maintain spinal stability and relieve pain. It is also suggested that when considering certain positions, for example lying supine, any additional physical and psychological factors that could affect patients because of this recommendation should be investigated.

There is currently no evidence base for the use or functionality of bracing. Some authors advise that when there is suspicion of cervical lesions, patients should be fitted with a cervical collar to help stabilise the spine and reduce neck movement (Maher de Leon 1998; Pease 2004). However, none of these authors have cited any original research or studies to support this statement. In fact, Heary 2001 points out that there is a lack of evidence for the long-term benefit of bracing in the literature, and that the (cervical) collar's effectiveness in preventing an impending pathological fracture is unknown.

In addition to potentially stabilising the spine, it is argued that a rigid spinal brace or orthosis may also help relieve pain and may be a conservative alternative to vertebroplasty (Galasko 1991; NICE 2008). Research studies are needed to clarify the role of bracing in MSSC and what effect bracing has on spine stabilisation, pain relief and quality of life, and whether there is any overall benefit of external braces or orthoses for MSCC patients.

There is a gap in the evidence base to inform positioning and bracing in individuals with MSCC. Despite published guidelines (NICE 2008), this review has demonstrated that evidence relating to spinal positioning and bracing is limited and inconclusive and therefore further research is required in this area.

Summary of main results

We intended to investigate the correct positions for patients with MSCC and examine the effects of spinal bracing to relieve pain or vertebral collapse, or both, under physiological load in this systematic review. The overall aim of the review was to provide evidence to assist healthcare professionals with their decision making in this area. Unfortunately the review process did not identify any studies that would guide healthcare professionals' decision making in this area. Furthermore, existing literature offers conflicting advice in terms of mobilisation and stabilisation.

From this systematic review the review authors conclude that clear guidelines are needed to inform how to correctly position patients in order to maintain spinal stability and relieve pain. Guidelines recommend using a spinal orthosis to increase spinal stability and to relieve pain (NICE 2008; White 1978; White 1990), however, from this review it can be concluded that there is no evidence to support this recommendation.

AUTHORS' CONCLUSIONS

Implications for practice

There is currently a lack of evidence regarding the effectiveness of spinal bracing for patients with MSCC. Further research and exploration of best practice in MSCC on positioning, bracing and spinal stability is required. Spinal bracing may improve comfort and quality of life for some patients but we are unable to make recommendations for practice based on this review.

Implications for research

Research to examine this topic needs to be undertaken to inform future practice. Randomised controlled trials to measure the efficacy of bracing would be possible. Descriptive and qualitative studies would be beneficial to clarify mobilisation and positioning from a physician, nursing and patient point of view.

ACKNOWLEDGEMENTS

We would like to thank Sheena Moffat, Information Services Advisor, Edinburgh Napier University, who refined and ran the search strategies for this review and the support of Jessica Thomas, Managing Editor, Cochrane Pain, Palliative and Supportive Care Review Group, UK.

REFERENCES

References to studies excluded from this review

Chi 2009 *{published data only}*
Chi JH, Gokaslan Z, McCormick P, Tibbs PA, Kryscio RJ, Patchell RA. Selecting treatment for patients with malignant epidural spinal cord compression, does age matter?. *Spine* 2009;**34**(5):431–5.

Freundt 2010 *{published data only}*
Freundt K, Meyners T, Bajrovic A, Basic H, Karstens JH, Adamietz IA, et al.Dose escalation for metastatic spinal cord compression in patients with relatively radioresistant tumors. *Strahlentherapie und Onkologie* 2010;**186**(4): 218–23.

Furstenberg 2009 *{published data only}*
Furstenberg CH, Wiedenhofer B, Gerner HJ, Putx C. The effect of early surgical treatment on recovery in patients with metastatic compression of the spinal cord. *The Journal of Bone and Joint Surgery* 2009;**91**(2):240–4.

Galasko 1991 *{published data only (unpublished sought but not used)}*
Galasko CSB. Spinal instability secondary to metastatic cancer. *The Journal of Bone and Joint Surgery* 1991;**73**(1): 104–8.

Ippolito 1998 *{published data only (unpublished sought but not used)}*
Ippolito V, Micheletti E, Saccalani M, Barbera F, Tonoli S, Motta C. Radiotherapy and spinal brace: still first-choice treatment for vertebral metastases from breast cancer. *Chirurgia Degli Organi di Movimento* 1998;**83**(1-2): 177–83.

Rades 2010 *{published data only (unpublished sought but not used)}*
Rades D, Schild SE, Abrahm JL. Treatment of painful bone metastases. *Nature Review Clinical Oncology* 2010;**7**:220–9.

Sciubba 2010 *{published data only (unpublished sought but not used)}*
Sciubba DM, Gokaslan ZL. Are patients satisfied after surgery for metastatic spine disease?. *The Spine Journal* 2009;**10**:63–5.

Spinazze 2005 *{published data only (unpublished sought but not used)}*
Spinazze S, Caraceni A, Schrijvers D. Epidural spinal cord compression. *Critical Reviews in Oncology Hematology* 2005; **56**:397–406.

Additional references

Benzel 2001
Benzel EC. *Biomechanics of Spine Stabilization*. New York: Thieme International, 2001.

Bilsky 1999
Bilsky MH, Lis E, Raizer J, Lee H, Boland P. The diagnosis and treatment of metastatic spinal tumor. *The Oncologist* 1999;**4**(6):459–69.

Bilsky 2006
Bilsky M, Smith M. Surgical approach to epidural spinal cord compression. *Hematology-Oncology Clinics of North America* 2006;**20**(6):1307–17.

Bilsky 2007
Bilsky MH, Azeem S. The NOMS framework for decision making in metastatic cervical spine tumors. *Current Opinion Orthopaedics* 2007;**18**:263–9.

Borm 2004
Borm W, Gleixner M, Klasen J. Spinal Tumors in co-existing degenerative spine disease - a differential diagnostic problem. *European Spinal Journal* 2004;**13**(7):633–8.

Bunting 2001
Bunting RW, Shea B. Bone Metastasis and Rehabilitation. *American Cancer Society* 2001;**Cancer Supplement, 92**(4): 1020–8.

Gasbarrini 2010
Gasbarrini A, Li H, Cappuccio M, Mirabile L, Paderni S, Gerzi S, Boriani S. Efficacy evaluation of a new treatment algorithm for spinal metastases. *Spine* 2010;**35**(15): 1466–70.

Gilbert 1978
Gilbert RW, Kim JH, Posner JB. Epidural spinal cord compression from metastatic tumor: diagnosis and treatment. *Annals of Neurology* 1978;**3**(1):40–51.

Heary 2001
Heary RF, Bono CM. Metastatic spinal tumors. *Neurosurgical Focus* 2001;**11**(6):1–9.

Higgins 2011
Higgins JPT, Green S, editors. Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0. www.cochrane-handbook.org 2011.

Jacobs 1999
Jacobs P. Malignant spinal cord compression. *Palliative Care Today* 1999;**8**(2):20–1.

Kwok 2005
Kwok Y, Regine WF, Patchell RA. Radiation therapy alone for spinal cord compression:Time to improve upon a relatively ineffective status quo. *Journal of Clinical Oncology* 2005;**23**(15):3308–10.

Levack 2002
Levack P, Graham J, Collie D, Grant R, Kidd J, Kunkler I, et al.Don't wait for a sensory level-listen to the symptoms: a prospective audit of the delays in diagnosis of malignant cord compression. *Clinical Oncology* 2002;**14**:472–80.

Lewandrowski 2006
Lewandrowski KU, McLain RF, Benzel EC. Bracing for patients with spinal tumours. In: McLain RF, Lewandrowski KU, Markman M, Bukowski RM, Macklis R, Benzel EC editor(s). *Cancer in the Spine: Comprehensive Care*. New Jersey: Humana Press Inc, 2006:337–41.

Loblow 1998
Loblaw DA, Laperriere NJ. Emergency treatment of malignant extradural spinal cord compression: an evidence-based guideline. *Journal of Clinical Oncology* 1998;**16**: 1613–24.

Maher de Leon 1998
Maher de Leon ME, Schell S, Rozental JM. Tumours of the spine and spinal cord. *Seminars in Oncology Nursing* 1998; **14**(1):43–52.

Makris 1995
Makris A, Kunkler IH. The Barthel Index in assessing the response to palliative radiotherapy in malignant spinal cord compression: a prospective audit. *Clinical Oncology* 1995; **7**:82–6.

McClinton 2006
McClinton A, Hutchison C. Malignant spinal cord compression, a retrospective audit of clinical practice at a UK regional cancer centre. *British Journal of Cancer* 2006; **94**:486–91.

Mercadante 1997
Mercadante S. Malignant bone pain: pathophysiology and treatment. *Pain* 1997;**69**(1-2):1–18.

NICE 2008
National Institute for Health and Clinical Excellence. Metastatic spinal cord compression, diagnosis and management of adults at risk of and with MSCC. National Collaborating Centre for Cancer 2008; Vol. Guideline 75.

Obbens 1987
Obbens EA, JB Posner. *Handbook of the Spinal Cord*. New York: Marcel Dekker, 1987.

Patchell 2005
Patchell RA, Tibbs PA, Regine WF, Payne R, Saris S, Kryscio RJ, et al.Direct decompressive surgical resection in the treatment of spinal cord compression caused by metastatic cancer: a randomised trial. *Lancet* 2005;**366**(9486):643–8.

Pease 2004
Pease NJ, Harris RJ, Finlay IG. Development and audit of a care pathway for the management of patients with suspected malignant spinal cord compression. *Physiotherapy* 2004;**90** (1):27–34.

Posner 1995
Posner JB. *Spinal Metastases*. Philadelphia: FA Davis Company, 1995.

Prasad 2005
Prasad D, Schiff D. Malignant spinal-cord compression. *Lancet Oncology* 2005;**6**:15–24.

Rades 2006
Rades D, Fehlauer F, Schulte R, Veninga T, Lukas JA, Hiba Basic S, et al.Prognostic factors for local control and survival after radiotherapy of metastatic spinal cord compression. *Journal of Clinical Oncology* 2006;**24**(21):3388–93.

Schiff 2003
Schiff D. Spinal cord compression. *Neurologic Clinics of North America* 2003;**21**:67–86.

Thomas 2006
Thomas KC, Nosyk B, Fisher CG, Dvorak M, Patchell RA, Regine WF, et al.Cost-effectiveness of surgery plus radiotherapy versus radiotherapy alone for metastatic epidural spinal cord compression. International Journal of Radiation Oncology, Biology, Physics 2006; Vol. 66, issue 4:1212–8.

Tokuhashi 2005
Tokuhashi Y, Matsuzaki H, Oda H, Oshima M, Ryu J. A revised scoring system for preoperative evaluation of metastatic spinal tumor prognosis. *Spine* 2005;**30**(19): 2186–91.

Walji 2008
Walji N, Chan AK, Peake DR. Common acute oncological emergencies: diagnosis, investigation and management. *Postgraduate Medical Journal* 2008;**84**(994):418–27.

White 1978
White AA, Panjabi MM. *Clinical biomechanics of the spine*. 1st Edition. Lippincott William & Wilkins, 1978.

White 1990
White AA, Panjabi MM. *Clinical Biomechanics of the Spine*. 2nd Edition. Lippincott William & Wilkins, 1990.

Yarbro 2005
Yarbro CH, Frogge MH, Goodman M. *Cancer Nursing: principles and practice*. 6th Edition. London: Jones and Bartlett, 2005.

* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Chi 2009	This RCT did not address the specific outcomes of bracing and positioning specified within this review
Freundt 2010	Retrospective study
Furstenberg 2009	Retrospective clinical trial
Galasko 1991	Retropective paper
Ippolito 1998	Retrospective study
Rades 2010	Review paper
Sciubba 2010	Commentary letter
Spinazze 2005	Review paper

DATA AND ANALYSES

This review has no analyses.

APPENDICES

Appendix 1. Search strategy

Search details
Database: MEDLINE (Ovid) (1950 - Week 4, January 2012)
1 Spinal Cord Compression/ (8856)
2 Spinal Neoplasms/ (10049)
3 (cord adj6 compress$).mp. [mp=title, original title, abstract, name of substance word, subject heading word] (11700)
4 compress$.mp. [mp=title, original title, abstract, name of substance word, subject heading word] (92673)
5 (epidural or extradural or extra-dural or "spinal cord" or "dural sac" or "cauda equina" or "spinal column").mp. [mp=title, original title, abstract, name of substance word, subject heading word] (169137)
6 metast$.mp. [mp=title, original title, abstract, name of substance word, subject heading word] (309497)
7 4 and 6 (2802)
8 5 and 7 (1542)
9 3 and 6 (1440)
10 1 and 6 (1004)
11 4 or 6 (399368)
12 2 and 11 (4564)
13 8 or 9 or 10 or 12 (5459)
14 randomized controlled trial.pt. (317022)
15 controlled clinical trial.pt. (83278)
16 randomized controlled trials/ (317022)
17 random allocation/ (72791)
18 double-blind method/ (112236)
19 single-blind method/ (15567)
20 14 or 15 or 16 or 17 or 18 or 19 (466167)
21 limit 20 to animal (50437)
22 limit 20 to human (425291)
23 21 and 22 (10855)
24 21 not 22 (39582)
25 20 not 24 (426585)
26 clinical trial.pt. (465272)
27 exp clinical trials/ (658195)
28 clin$ with trial$.tw. (1)
29 placebos/ (30346)
30 placebo$.tw. (131982)
31 random$.tw. (536852)
32 exp research design/ (291693)
33 26 or 27 or 28 or 29 or 30 or 31 or 32 (1109414)
34 limit 33 to animal (137432)

(*Continued)*

35 limit 33 to human (969521)
36 34 and 35 (36247)
37 34 not 36 (101185)
38 33 not 37 (1008229)
39 comparative study/ (1549101)
40 exp evaluation studies/ (158314)
41 follow-up studies/ (433321)
42 prospective studies/ (307204)
43 (control$ or prospectiv$ or volunteer$).tw. (2410885)
44 39 or 40 or 41 or 42 or 43 (4045378)
45 limit 44 to animal (1185597)
46 limit 44 to human (2811222)
47 45 and 46 (268529)
48 45 not 47 (917068)
49 44 not 48 (3128310)
50 25 or 38 or 49 (3563872)
51 13 and 50 (1259)
Database: EBM Reviews - Cochrane Central Register of Controlled Trials (Ovid) (13th February 2012)
1 Spinal Cord Compression/ (176)
2 Spinal Neoplasms/ (53)
3 (cord adj6 compress$).mp. [mp=title, original title, abstract, mesh headings, heading words, keyword] (227)
4 compress$.mp. [mp=title, original title, abstract, mesh headings, heading words, keyword] (4198)
5 (epidural or extradural or extra-dural or "spinal cord" or "dural sac" or "cauda equina" or "spinal column").mp. [mp=title, original title, abstract, mesh headings, heading words, keyword] (9043)
6 metast$.mp. [mp=title, original title, abstract, mesh headings, heading words, keyword] (11966)
7 4 and 6 (137)
8 5 and 7 (94)
9 3 and 6 (90)
10 1 and 6 (85)
11 4 or 6 (16027)
12 2 and 11 (36)
13 8 or 9 or 10 or 12 (118)
Database: EMBASE (Ovid) (1980 - Week 4, January 2012)
1 Spinal Cord Compression/ (10115)
2 Spinal Neoplasms/ (10648)
3 (cord adj6 compress$).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (12916)
4 compress$.mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (120236)
5 (epidural or extradural or extra-dural or "spinal cord" or "dural sac" or "cauda equina" or "spinal column").mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (204093)
6 metast$.mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name] (410521)
7 4 and 6 (4386)
8 5 and 7 (2535)
9 3 and 6 (2282)
10 1 and 6 (1894)
11 4 or 6 (526371)
12 2 and 11 (3537)

(*Continued*)

13 8 or 9 or 10 or 12 (5610)
14 controlled-study.sh. (3681534)
15 crossover-procedure.sh. (31733)
16 double-blind-procedure.sh. (102763)
17 phase-3-clinical-trial.sh. (12924)
18 placebo$.tw. (164540)
19 randomized-controlled-trial.sh. (296357)
20 single-blind-procedure.sh. (14735)
21 blind$.tw. (215213)
22 comparative study.tw. (57320)
23 (control$ adj1 trial$).tw. (109556)
24 cross?over$.tw. (40482)
25 factorial$.tw. (17764)
26 random$.tw. (679440)
27 or/14-26 (4206739)
28 human.sh. (12805189)
29 nonhuman.sh. (3780391)
30 28 and 29 (700996)
31 29 not 30 (3079395)
32 27 not 31 (2789445)
33 13 and 32 (489)
Database: CINAHL (EBSCO) (1982 - January 2012)
1 (MH "Spinal Cord Compression") (633)
2 (MH "Spinal Neoplasms") (797)
3 cord N6 compress* (0)
4 compress* (11478)
5 epidural or extradural or extra-dural or "spinal cord" or "dural sac" or "cauda equina" or "spinal column" (23972)
6 metast* (21071)
7 S4 and S6 (376)
8 S5 and S7 (285)
9 S3 and S6 (0)
10 S1 and S6 (133)
11 S4 or S6 (32173)
12 S2 and S11 (378)
13 S8 or S9 or S10 or S12 (577)
14 (MH "Random Assignment") (123)
15 (MH "Random Sample") (38)
16 (MH "Crossover Design") (34)
17 (MH "Clinical Trials+") (9473)
18 (MH "Comparative Studies") (217)
19 (MH "Control (Research)+") (60)
20 (MH "Factorial Design") (10)
21 (MH "Quasi-Experimental Studies") (37)
22 (MH "Nonrandomized Trials") (5)
23 (MH "Placebos") (655)
24 (MH "Meta Analysis") (827)
25 (MH "Clinical Nursing Research") or (MH "Clinical Research") (3081)
26 (MH "Community Trials") (9)
27 (MH "Experimental Studies") (306)

(*Continued*)

28 (MH "One-Shot Case Study") (6)
29 (MH "Pretest-Posttest Design") (13)
30 (MH "Solomon Four-Group Design") (2)
31 (MH "Static Group Comparison") (0)
32 (MH "Study Design") (2795)
33 (MH "Clinical Trials") (9188)
34 (MH "Systematic Review") (748)
35 TI random* (752)
36 TI singl* or doubl* or tripl* or trebl* (51229)
37 TI blind* or mask* (14161)
38 S36 and S37 (5962)
39 TI cross?over* or placebo* or control* or factorial or sham (518186)
40 TI clin* or intervention* or compar* or experiment* or preventive or therapeutic (736416)
41 TI trial* (42588)
42 S40 and S41 (29996)
43 TI counterbalance* or multiple baseline* or ABAB design* (526)
44 TI meta?analy* or systematic review* (26808)
45 S14 or S15 or S16 or S17 or S18 or S19 or S20 or S21 or S22 or S23 or S24 or S25 or S26 or S27 or S28 or S29 or S30 or S31 or S32 or S33 or S34 or S35 or S38 or S39 or S42 or S43 or S44 (553687)
46 S13 and S45 (127)

HISTORY

Protocol first published: Issue 1, 2009

Review first published: Issue 3, 2012

CONTRIBUTIONS OF AUTHORS

Draft the protocol: MC, LK, CK

Develop a search strategy: MC, LK, CK, SM

Search for trials: MC, LK, CK, SHL, RG

Obtain copies of studies and updated search strategy February 2012: SHL

Select which studies to include: LK, CK, SHL, RG

Draft the final review: LK, CK, SHL, RG

Update the review: LK, CK, SHL, RG

DECLARATIONS OF INTEREST

None known

SOURCES OF SUPPORT

Internal sources

- Edinburgh Napier University, UK.
- NHS Lothian, UK.

External sources

- No sources of support supplied

INDEX TERMS

Medical Subject Headings (MeSH)

*Braces; Joint Instability [*therapy]; Pain Management [*methods]; Patient Positioning [*methods]; Spinal Cord Compression [*complications]; Spinal Neoplasms [secondary]; Spine

MeSH check words

Humans